

A CASE OF SUTURE OF THE SPINAL CORD FOLLOWING A GUNSHOT INJURY INVOLVING COMPLETE SEVERANCE OF THE STRUCTURE.¹

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A. E., aged eighteen years; clerk; born in the United States; single; was admitted to the Brooklyn Hospital on April 28, 1903, with the following history:

Shortly before admission he had been shot in the back, his assailant using a .38-caliber revolver at a distance of about thirty feet; the shooting took place somewhat from the right side. He suffered severely from shock, and paralysis of the lower extremities occurred at once.

Examination on admission. The bullet wound was located one and one-fourth inches to the right of the median line and on a level between the tenth and eleventh dorsal spines. He is found to be paralyzed below the waist, sensation is absent over all of both lower extremities and over the abdomen as high as one inch above the crest of the ilia on the sides, and about half-way between the symphysis and the umbilicus in front. The bladder and rectum are also paralyzed. The bowels move involuntarily and irregularly and without the volition or cognizance of the patient; there is considerable twitching of the muscles of both legs, especially the toes.

Operation May 9, 1903. Ether anæsthesia. An incision was made six inches long over the spines of the vertebræ, the middle of the incision resting upon the eleventh dorsal spine. The laminae of the tenth, eleventh, and twelfth vertebræ were removed by the chisel. The bullet was found lying transversely between the severed ends of the cord, concealed from view by a large blood-clot. A very narrow, ragged, and contused strip of dura,

¹ Read before the American Surgical Association, July 6, 1905.

scarcely more than one-eighth of an inch in width, remained intact. The blood-clot was carefully sponged away and the bullet removed. The ends of the cord were then sutured with three fine chromicized catgut sutures, the dura being included in the sutures. No special difficulty was experienced in drawing together the ends of the cord and closing the defect, the latter representing in width the diameter of the .38-caliber bullet. The dura was further secured with a number of sutures of fine catgut, and a drain consisting of a half-dozen narrow strips of oiled silk protective introduced. The skin incision was sutured with silk-worm gut.

On May 30 the following note appears on the hospital record: "Wound healed, upper line of anæsthetic area from one and one-half to three inches lower than before operation. Twitching of toes of both feet and occasional clonic muscular spasms of the flexors and extensors of the thighs; the patient says his 'feet jump up on him.' Can feel when the bowels move, but is without control of the rectum. Can feel distention of the bladder with urine, but is without control." „

Examination by Dr. William Browning on June 7.—It is found that no sensation can be definitely determined in the lower extremities which responds to any test, except where some muscular contraction occurs following motions producing pain, as spasm by jarring. There are frequent slight movements in the toes, these being noticeably present in the big toes. There is no cremaster jerk; the knee-jerk cannot be developed even by pulling down the patella. Ankle clonus is absent; Achilles jerk present on both sides. It is not certain that he can move either toe at will; occasionally he would appear to do so, but more often the motion would be in the other foot; in fact, there is so much spontaneous motion as to make what otherwise might appear to be a movement in response to the will purely accidental. Babinski's reflex in extension symptom (the upward jerk of the toes) is present on each side; there is also some upward motion of the toes on plucking out hairs on the front of each leg.

During July bed-sores developed on the buttocks and heels. These became quite deep, the sacral sore extending to the muscles. During November a cystitis developed, and irrigation of the bladder was done daily for about eight weeks, and urotropine, four grains every four hours, administered. Under this treatment the

cystitis improved. Patient was encouraged to sit up and go about in a wheel-chair, when the bed-sores healed rapidly. In January, 1904, a lobar pneumonia developed, from which the patient recovered without any untoward event. During the spring and summer of 1904 the sensation of the presence of the contents of the bladder and rectum was greatly improved. Occasional recurrences of cystitis were kept under control by irrigation and urotropin. Following the healing of his bed-sores he was treated by massage and electricity, and has taken daily walking exercises, assisted by an attendant, in a cage-like support resting on wheels, arranged somewhat like the "baby-tender" of the nursery. With the aid afforded by this support and braces to stiffen the knees, he manages to move about from place to place in the hospital.

During the winter of 1904 and 1905 his bladder and rectal sensations improved. He is now able to tell when a movement of the bowels is imminent, and at times is able to retain it for awhile. The same is true of the bladder. Erections are easily excited and persistent, but not painful. Both legs are spastic and quite useless for locomotion, except with the help of the apparatus above mentioned.

The following is a report of his condition in January, 1904, by Dr. F. C. Eastman, assistant in neurology at the Brooklyn Hospital:

Sensation.—This is abolished in the legs and trunk as high as a line extending across the front of the body at a point one and one-half inches above the pubes, and in the back represented by a curved line about half an inch below the level of the iliac crests. Above this there is a zone of marked hyperæsthesia about two inches in width, though there is some irritability of the whole cord above the level of anaesthesia. There is an area about five inches in length extending down the outer side of the right thigh where there seems to be some sensation, but the patient is not able to correctly distinguish between heat and cold, nor is he able to correctly localize tactile sensations, which are usually referred to a point two or three inches distant.

Voluntary motion is completely lost in the affected area. There is loss of bladder and rectal control, the former at least acting automatically; the patient is able to tell just before the act that he is about to urinate.

The abdominal and cremasteric reflexes are lost. Virile and

epigastric reflexes present. The knee-jerks are exaggerated, particularly the left. The Achilles reflex marked, particularly on the right side. Right Babinski reflex more marked than left. Permanent right ankle clonus is absent on the left side. Marked rigidity and spasticity of both legs. Tendency to priapism. Left leg one-quarter of an inch larger than the right. Left thigh one-quarter of an inch larger than the right.

Trophic Changes.—Slight atrophy of both legs, probably from disuse. Marked atrophy of glutei muscles on both sides. The muscles involved are apparently situated too far down for this atrophy to be the result of destruction of the cells of the anterior horn at the point of lesion, so that it may be simply from disuse, as these muscles atrophy more readily than any others in the body.

The skin is somewhat dry and scaly, but there is very little trophic disturbance at the present time.

Examination made by Dr. Eastman on the 12th of June, 1905, shows the data to be practically identical upon comparison with the former report, with the following exceptions: In the former examination it was stated that the anæsthesia extended upward in front to a point one and one-half inches above the pubes. It is now found that the anæsthesia extends to the pubes and no further; the area of anæsthesia on the right leg and on the back, however, corresponds perfectly with the former findings. There is no reaction of degeneration of any of the leg, thigh, or gluteal muscles.

Remarks.—The main points of interest in this case relate to the possibility of regeneration of the spinal cord following a destructive lesion. Prior to the case reported by Dr. F. F. Stewart and Dr. R. H. Harte, in which the cord was sutured after it had been severed by a bullet, it was the opinion of the majority of investigators that such regeneration in man did not take place. Mikulicz, of Breslau, endeavored to demonstrate the possibility of a successful regenerative process in the lower animals following section of the cord, but without result. Spiller and Frazier found that after division of a posterior root in the dog, followed by immediate suture, regeneration occurs, and that regeneration into the cord does not occur.

In comparing the result in the case reported by Dr. Stewart with the conditions present in the case herewith reported, the following points are worthy of note: Sixteen months after the injury, in Dr. Stewart's case, the patient was able to flex the toes, flex and extend the legs and thighs, and rotate the lower extremities. While in the sitting position she could raise the extended leg from the floor, and she was able to stand by supporting herself with her hands on the back of a chair. The bowels were under control except when diarrhœa was present, and moved every second day. The urine passed voluntarily amounted to about sixteen ounces in twenty-four hours; incontinence occurred during sleep. She had the sensations of touch, temperature, pain, and locality; the difference between heat and cold, however, was not always distinguished. Rigidity of the muscles was present in a moderate degree; both ankle clonus and patellar clonus were present on each side. Reaction of degeneration absent. No bed-sores had ever developed, and the skin and nails showed no trophic changes.

In the case herewith reported, the following is to be noted in comparison: Twenty-six months after the injury voluntary motion is practically lost in the affected area. He is able to stand when supporting himself by the hands resting upon an apparatus, and to make some locomotion by swinging movements in a special frame on wheels. The bladder and rectal control is doubtful, to say the least, the former acting automatically. He has the sensation that the bladder and rectum are about to empty themselves, and if the urinal or bedpan is brought to him promptly soiling is prevented. The amount of urine passed in this manner would probably average more than a pint in the twenty-four hours. Urine is sometimes voided during sleep. Sensation is practically abolished in the entire affected region, with the exception of an area about five inches in length extending down the outer side of the right thigh, where some sensation is present. He is not able to correctly distinguish between heat and cold. Tactile sensations are recognized, but are usually referred to a point two or three inches distant from the point touched. Marked rigidity and

spasticity of both legs are present. Patellar reflex exaggerated; Achilles reflex marked. Ankle clonus present on one side and absent on the other. The reaction of degeneration is absent. Upon this point, Dr. Eastman reports as follows:

"I examined E.'s muscles as you desired, and can report that there is no reaction of degeneration of any of the leg, thigh, or gluteal muscles; further than that I cannot say positively. I could not get the reaction in any of the muscles that I tried. The trouble is that the back and abdominal muscles, which are supplied with nerves from the point of the lesion, are innervated from so many segments that lesion of any one segment does not destroy their activity, and then I could not react at all some of the muscles in the deeper layers of the back." Bed-sores developed in the third month; these extended to the muscles and were six months in healing. The skin shows but slight, if any, evidences of trophic disturbance.

An important comment is suggested in comparing these cases, namely, the Stewart-Harte case was operated on three hours after the injury, while in the present case upward of ten days had elapsed before consent to interfere operatively was obtained. The prolonged separation of the divided ends of the cord and the presence of the foreign body had, in all probability, an influence in preventing a complete regeneration of the cord, as occurred in the first case, provided, of course, that regeneration does actually occur. While the case in hand is therefore not as striking in many of its features as the Stewart-Harte case, it presents some points of interest, and for this reason is offered as a contribution to the literature of the subject.

Finally, the influence exercised by the possible presence of undiscovered portions of the cord, or of nervous structure in portions of the dura remaining intact in these and similar cases, may be taken into account. It may be that this takes place also in connection with injury of the cord occurring as the result of fracture of the vertebræ, and the varying end result of operative interference in different cases may be accounted for in a

measure by the varying extent to which a final nerve anastomosis may take place through the medium of uninjured portions of the dura. This suggests likewise the occurrence of a relatively efficient nerve anastomosis through the medium of branches of adjacent nerve-trunks having their origin respectively above and below the lesion, and this in turn to the possibility of still further enhancing this effect by operative anastomosis of the nerve-trunks themselves. This, of course, assumes a relative limitation of the ascending degenerative process with elements of the cord as well as of the axis-cylinders of the divided and sutured nerve-trunks, and resulting innervation of the parts below the lesion and of those supplied by the injured segment of the cord, conditions not incompatible with those that may have been obtained in the Stewart-Harte case, and to a lesser extent in my own case.